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CONTENTS

The Vertebrate Zoologist and National Efficiency: WALTER P. TAYLOR 123

The Status of the Graduate Degree in Medicine: DR. LOUIS B. WILSON 127

Scientific Events:—

The Research Corporation; Anthracite Coal mined in 1916; Animal Collections from Australia 131

Scientific Notes and News 133

University and Educational News 139

Discussion and Correspondence:—

Climatic Index of Bonneville Lake Beds: DR. CHARLES KEYES. *Internal Telia of Rusts:* PROFESSOR ERNEST SHAW REYNOLDS. 139

Proceedings of the National Academy of Sciences 141

Special Articles:—

The Swelling of Gelatine and Agar Gels in Solutions of Sucrose and Dextrose: E. E. FREE 142

The American Chemical Society 143

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THE VERTEBRATE ZOOLOGIST AND NATIONAL EFFICIENCY

THE American government having been forced into the war, it is the privilege of American scientific institutions and of the army of American scientific men to adapt themselves at once to the new conditions, and to hold themselves in readiness to serve wherever their contribution is most needed.

At no time in the world's history has the necessity of thoroughgoing scientific preparation been emphasized as it is at present. For some time it has been clear that the war is a war of physics and chemistry. The pressing agricultural and medical problems of to-day make it sharply apparent that the war is no less a war of biology. Other things being equal, those national groups win which are best prepared scientifically.

A moment's consideration of certain problems, chiefly agricultural, which the war has thrown into strong relief serves to demonstrate the essentiality of knowledge of the complicated relations between man and his environment. By furnishing aggressive and intelligent leadership in this province the vertebrate zoologist can make a contribution of supreme and immediate importance to the national efficiency.

We may now proceed to discuss five propositions which stand out predominantly in this connection.

First, the possibility of the development of new resources in food or clothing is indubitable; there is no great hope for the successful elaboration of plans looking to this end, however, without intimate knowledge of the wild stock which it is proposed to domesticate or otherwise develop.

The Biological Survey has on more than one occasion called attention to the vast possibilities in wild game mammals as a source of food. Of interest in connection with the present critical shortage in the food supply of the world are the following words of Lantz[1] written in 1910:

> It is believed that with proper encouragement much of the otherwise waste land in the United States may be made to yield profitable returns from the production of venison, and that this excellent and nutritious meat, instead of being denied to 99 per cent. of the population of the country, may become a common food product.

The Honorable Franklin K. Lane, Secretary of the Interior, as reported by the daily press, recently called attention to the reindeer as a possible source of increased food supply. It has been lately suggested by J. B. Harkin, commissioner of parks for the Dominion of Canada,[2] that the barren-ground caribou, 20,000,000 strong, constitute a valuable potential meat supply. Some years ago Mr. Charles Goodnight, of Goodnight, Texas, conducted some most promising breeding experiments with the buffalo,. crossing the animals principally with Polled Angus cattle, and securing fertile hybrids which ate less, put on more flesh with the same amount of food, cut more meat, and were subject to fewer diseases than the steer. Similar experiments have been carried forward by C. J. Jones, of Topeka, Kansas, and Mossom Boyd, of Bobcaygeon, Ontario, Canada, and are now being prosecuted by the Canadian Department of Agriculture. It is hoped that there may be produced an improved range animal, having 100 pounds more meat than the steer, and in addition possessing the valuable robe and rustling ability of the buffalo. The American Breeder's Association has gone on record as appreciative of the possibilities of increasing our national food supply through fuller utilization by domestication of wild birds and mammals. A recent writer in Science (Needham, April 20, 1917) wisely argues that the possibilities of undeveloped economic values in the wild species constitute an important argument for their preservation.

Second, since life is an active process, and new adaptations and adjustments are continually appearing in the complex of living things about us, man must be alert and on guard against new parasites and disease germs of one sort or another, which may be borne and distributed by animal hosts, either to valuable live stock or to man himself.

While the rôle of flies and mosquitoes as bearers of disease is well understood, that of certain mammals is not fully appreciated. In the Old World the rat is chiefly responsible for the spread of bubonic plague through its acting as host to the flea, which is the direct agent of transmission of the disease to the human being. The introduction of plague into the United States has been threatened at least once, in Seattle in 1915, and has actually occurred twice, in San Francisco in 1907–08 and in New Orleans in 1914. The most serious of these introductions took place in San Francisco and vicinity, where a part of the ground squirrel (*Citellus beecheyi*) population became infected from the rats, and threatened to disseminate the plague widely through the state. Attention has already been called to the fact that probably all kinds of rat fleas transmit plague.[3] The susceptibility to the disease of the fleas of ground squirrels suggests the possibility that the fleas of other rodents also may be potential transmitters of plague.

In addition to their plague-bearing proclivities, rats disseminate trichinosis among

[1] Biol. Surv. Bull. 36, p. 59.

[2] *Bull. Amer. Game Prot. Assn.*, May 1, 1917, p. 8.

[3] *Biol. Surv. Bull.* 33, 1909, p. 32.

swine; and a note in *Nature*[4] suggests that the causative organism of epidemic jaundice, which has occurred of late on the western front in Europe, probably has its natural habitat in the rat. Examples of other mammal-borne diseases are found in the Rocky Mountain spotted fever, transmitted through the agency of ticks borne by rodents in Montana and Idaho, and rabies, carried by coyotes and dogs in Nevada and California.

Third, the resources of nature are distinctly limited in amount, and man should know what and where these resources are, that accurate determination may be made of the amount and kind of use which may be permitted as being compatible with a regard for the rights of all the people, and of future generations.

In the matter of conservation of her natural resources America has been perhaps the most backward of all civilized peoples. She has permitted undue exploitation of all of her resources by selfish commercialism. In no province is this more apparent than in that of the wild life, where it is well known that some of the most valuable and interesting mammals and birds have been exterminated, and others dangerously reduced.

Fourth, the perpetuation of interesting and rejuvenating natural objects, including scenery, forests and wild life, demands detailed and accurate knowledge of all the objects to be preserved.

Many signs indicate that the people are coming to realize, as never before, the recreative value of the preservation of nature. The hearty support given the Department of the Interior in its epoch-making work for the national parks and that accorded the Department of Agriculture in its comprehensive forest, bird and game protective activities are full of meaning in this connection.

[4] January 18, 1917, p. 393.

Fifth, a more intensive agriculture brings man into more strenuous competition with certain insect and mammalian pests; for the successful maintenance of farming and horticulture man must know both his friends and enemies in the animal world; he must be prepared to perpetuate beneficial species, and he must be ready to control or exterminate those which are detrimental.

Disturbance of the balance of nature, having to do with increased competition between man and certain pests, is effected in several ways, of which the following are important: Destruction of carnivorous or predatory birds and mammals; reduction in numbers of game birds and mammals; introduction of useful domesticated species of plants and animals; involuntary or mistaken introduction of harmful exotic species of plants and animals; cultivation of the soil and the raising of crops; removal of the natural cover of forest and brush.

Some of these disturbing factors, notably the increase in the supply of rodent food provided by growing crops, and, all too often, the ill-advised destruction of natural checks on rodent increase, such as hawks, owls, badgers, skunks, weasels and other predatory animals, indicate that rodent outbreaks may be expected to occur more frequently in the future than they have in the past, and it is well known that plagues of rodents have harassed mankind at intervals since the dawn of history.

In Nevada in 1907 and 1908 meadow mice of the genus *Microtus* overran four fifths of the cultivated area in the lower Humboldt valley leaving a "dismal scene of destruction," and necessitating the complete replanting of much alfalfa land.[5] Depredations of cotton rats (*Sigmodon*) in certain sections of the middle west, notably southern Kansas and Oklahoma, in the

[5] Piper, Yearbook, U. S. Department of Agriculture for 1908, 1909, p. 302.

spring of 1915–16, were so severe that in some instances no less than three plantings of corn had to be made.[6] A serious outbreak occurred during 1916 in the province of Foggia in Apulia, Italy,[7] where the grain crop is reported to have been almost entirely destroyed by inordinate increase of voles of the genus *Pitymys;* and in the fertile Shenandoah valley, Virginia, where a thriving fruit industry is conducted, mice belonging to the same genus have become so abundant and so troublesome during the spring of 1917 that in some orchards they have girdled and killed seventy-five per cent. of the trees.[7]

That the steady drain upon our agricultural products caused by various noxious rodents over a large part of the country when present in normal numbers is of even greater consequence to our agricultural welfare than the damage from plagues has already been emphasized by Lantz.[8] Some idea of the extent of this damage may be gained from the following figures, gathered recently by the chief of the Biological Survey.

The annual loss to grain crops through the agency of ground squirrels in North Dakota on the basis of present prices is estimated by authorities at the State Experiment Station to aggregate more than $6,000,000.

A. E. Bowman, director of the State Agricultural Extension Service, Wyoming, states that 15 per cent. of the crops within that state are destroyed annually by rodents.

The annual losses from rodents in the state of Kansas are placed at $12,000,000.

The department of biology of the Montana Agricultural College estimates that the crops in that state suffer annual losses through ravages of rodents amounting to $15,000,000 to $20,000,000.

These are isolated reports concerning a situation which is general; a conservative estimate places the probable losses to agriculture from noxious native rodents in the western and Pacific states alone at more than $100,000,000 annually.

In 1909 fire losses and losses to grains and other merchandise due to European rats and mice were estimated to aggregate $59,917,000 annually.[9] Assuming that the amount of damage done by these rodents is approximately the same now as then, it is not improbable, at present prices of grain and other merchandise, that the annual losses will aggregate at least $100,000,000. Suggestions made by Creel[10] and Forbush[11] indicate that even this figure may be far too low. The former estimates that each rat costs one half a cent per day, or $1.82 per year, to feed; and the latter calls attention to the fact that on the basis of Creel's estimate, assuming that the rat population is the same as the human population, the annual cost to the country is $182,000,000; and both these suggestions were made when the price of wheat was less than half what it is at present.

The cogency of these facts is more than ever apparent during the present growing season. Weather conditions have been unfavorable, labor is scarce and the winter wheat crop is reported to be the shortest in years. All practicable steps should be taken, not only to increase acreage, but to guard against local or general plagues of insects or rodents, and to cut down to the minimum the enormous losses which heretofore have occurred continuously. The saving of grain which will be effected through

[6] Reported by Professor D. E. Lantz, Biological Survey.

[7] *Nature,* December 28, 1916, p. 338.

[8] *Biol. Surv. Bull.* 31, 1907, p. 8.

[9] C. Hart Merriam, Rept. Nat. Conservation Commission, Vol. 3, pp. 339–340.

[10] U. S. Public Health Reports, 28, 1913, p. 1405.

[11] Bull. No. 1, Econ. Biol., Mass. Board of Agriculture, 1915, p. 25.

up-to-date and aggressive methods of rodent control will furnish an increased food supply for America and her Allies which will help to guarantee just that margin of advantage in the world struggle which will be necessary to victory.

Essential to action regarding any of the problems discussed in this paper, whether the domestication of and development of new resources from wild stocks, the protection or propagation of those which are beneficial, or the control or destruction of detrimental species, is an intimate and accurate knowledge of nature. And this knowledge can only come, in any comprehensive and authoritative way, through the collection of series of specimens, with the associated study, in field and laboratory, of the distribution, systematic relationships, habits, economic status and ecology of the animals concerned.

The present-day organization of American science delegates this task to the vertebrate zoologist in college or university, museum of natural history, or government laboratory.

It should ever be the obligation of the scientific man to labor for the public good. With a world to help feed, and a war to help win, it now becomes peculiarly the duty and privilege of the American scientific man to make increased practical application of technical information, in short, to furnish a large measure of cooperation and leadership in the struggle to make democracy efficient and so to secure the benefits of government by the people for the nations of to-day and the generations of the future.

WALTER P. TAYLOR
BIOLOGICAL SURVEY

THE STATUS OF THE GRADUATE DEGREE IN MEDICINE[1]

THE University of Minnesota is offering graduate work in the various fields of medicine and surgery in three-year courses open to students who already possess the bachelor's degree, or its equivalent, the doctor's degree in medicine from a Class "A" medical school, and who have had at least one year's internship in a general hospital or a year's service in an approved laboratory of the medical sciences. On the satisfactory completion of such a three-year course, the student is eligible for the degree of Doctor of Science in internal medicine, in surgery, in pathology, or in whatsoever other branch of medicine he may have chosen his major subject.

The status of this new degree of Doctor of Science in a medical specialty has not yet been determined; hence the following analysis and discussion. Since the conditions laid down regarding admission, residence, language requirements, thesis and examinations are those which have long been applied by graduate schools of universities in the approval of candidates for the degrees of Doctor of Philosophy or Doctor of Science, it has been assumed by some that the new degree in medicine scholastically reaches only the level of these older degrees. This assumption would seem to be incorrect, first because of the longer time required to obtain the degree, and, second, because of the scientific ability exhibited by men with only the formal schooling represented by the doctorate in medicine or the baccalaureate in arts or sciences.

In the following diagram is shown the relationship in point of time required for the attainment of the M.D. degree in schools with the "Minnesota standard" and the attainment of the Ph.D. degree in universities in general, as well as the additional time required for the attainment of the new degree of Doctor of Science in a medical specialty.

It will be noted from the diagram that four students, *A*, *B*, *C* and *D*, who have had the necessary high-school or other preparatory training, enter the college of literature, science and the arts of the university at the same time and pursue regularly prescribed courses. At the end of two years in college, during which time he has taken a preponderance of prescribed physical, chemical and biological studies, *A* transfers to the medical school, and

[1] Presented before the Minnesota Academy of Medicine, St. Paul, Minnesota, October 11, 1916.

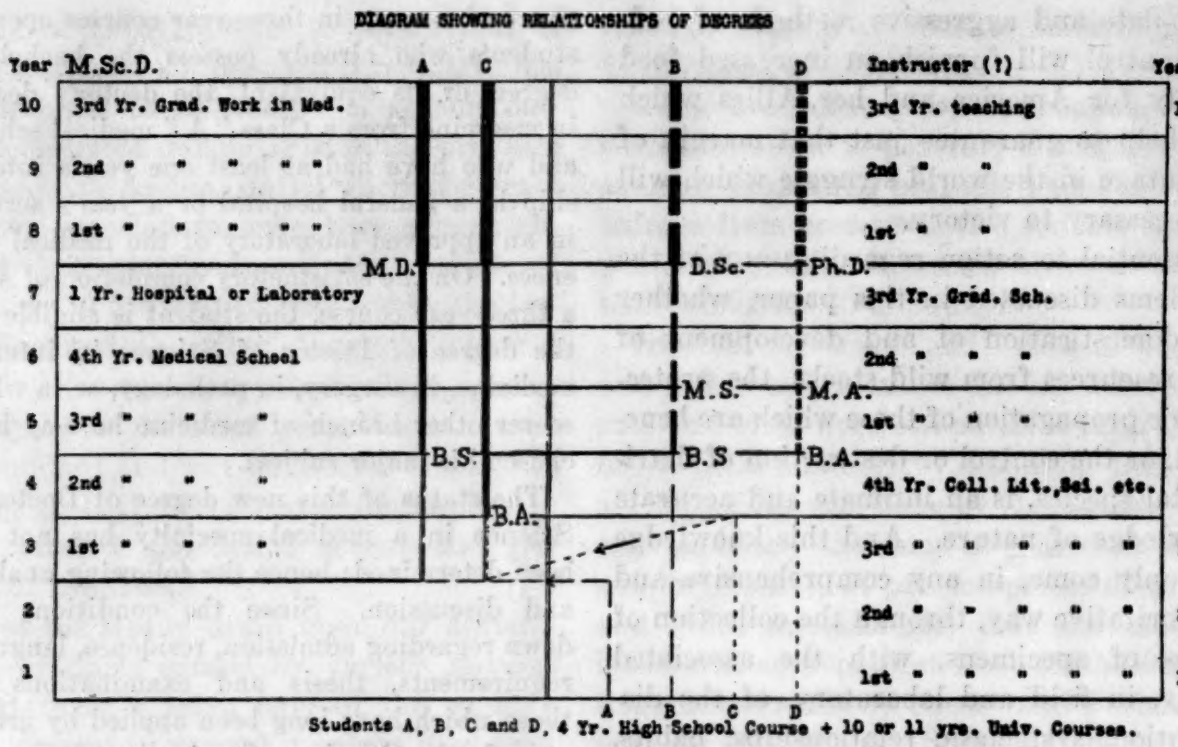

Diagram showing Relationships of Degrees

Students *A*, *B*, *C* and *D*, 4-year high-school course + 10 or 11 yrs. university courses.

takes therein two years more work, at the end of which time—a total period of four years—he receives his B.S. degree. *B*, taking a preponderance of prescribed physical, chemical and biological sciences, at the end of four years, all spent in the college, also receives his B.S. degree. *C*, entering the same college, but in addition to the required physical, chemical and biological sciences, adding thereto the special study of literature and the arts, at the end of three years in the college transfers to the medical school and in one year more, or after a total period of four years, receives his A.B. degree. *D*, entering the college and not indulging in a preponderance of the physical, chemical and biological sciences, but giving special attention to literature and the arts, receives his A.B. degree at the end of four years. Thus, each receives a bachelor's degree at the end of four years. If all four continue in the schools in which they were working at the time they received their bachelor's degree, *B* and *D* will receive their master's degrees at the end of another year and their doctorate degrees in science and philosophy, respectively, at the end of three years. Similarly *A* and *C*, after two and three more years respectively in the medical school and one year in an approved hospital or laboratory, will receive their doctor's degrees in medicine. Therefore at the end of seven years in the cases of *A*, *B* and *D*, and of eight years in the case of *C*, all four have attained the doctorate degree. It would appear that men starting on the new three-year graduate courses in medicine offered by the University of Minnesota in the clinics and laboratories in the Medical School in Minneapolis and in the Mayo Foundation in Rochester, already have spent as much time in making their approach to the study of medical specialties as that required for obtaining the Ph.D. or D.Sc. degree in good institutions.

It is improbable that the native ability, the preparatory school instruction, the habits of study or the skill of their university instructors, in the long run, is either better or worse in the group of doctors of medicine than in that of doctors of philosophy or science. Yet all will agree that, broadly speaking, there is a difference in the scientific attitude and habits of thought in the men of the three

groups. This difference is best explained by the fact that of the four students whose scholastic careers have been diagramed above, *B* and *D* have usually placed most intensive study on a very small field of science or art, while *A* and *C* have given less intensive study to a relatively much broader field. Incidentally also, *A* and *C* are apt to have come more closely in contact with living conditions, with science in the making as it were, than have *B* and *D*. The question is open to discussion whether *B* and *D* may not have concentrated too early and may not later suffer from lack of a broad knowledge of the science in the narrow field in which they have specialized and of other sciences related thereto. Some of the possibilities in this respect are pointed out by Stephen Leacock in one of his delightful "Essays and Literary Studies." Be this as it may, certainly *A* and *C* at least should be well able to see the broader relationship of narrow lines of scientific investigation. The question of present concern, however, is not the breadth of their culture—which unfortunately is usually all too narrow to enable them to get the most real enjoyment out of life—but rather the amount of their scientific ability, *i. e.*, their ability to utilize in new ways old scientific truths and to discover, as well as to utilize, new scientific truths.

his native ability or the amount of his premedical and graduate study not represented by formal schooling. But in comparing large groups these factors may fairly be assumed to approximately cancel each other.

Turning then to the question in hand—namely, the relative scientific ability of men who have ended their schooling with the attainment of the M.D. degree as compared with those who have obtained the Ph.D. degree, we may, I think, start with the premise that medical science in America has at least kept abreast with any other science during the last quarter of a century. We might indeed be within the truth in saying that it has led in development, but for the purpose of the present essay, it is but necessary to assume that it has been equal to any other. The second premise, which we may lay down without question, is that the progress in medical sciences has been made by the men who are in the medical profession. It may further be postulated that in the United States most of the men who are responsible for the progress of medical science are members of the various medical societies whose membership is limited to those who have attained some distinction in some special field of medicine. It is presumable that there are instances of general practitioners who are not members of any society

TABLE I

Analysis of Scholastic Degrees of Members of Certain Clinical Medical Societies

Name of Society	Total Number Members Whose Degrees Were Found	Percentages.			
		Total M.D.	M.D. Only	M.D. and A.B. or Equiv.	M.D. and Ph.D.
American Surgical Association	169	100	55	43	2
Association of American Physicians	147	100	32	63	5
American Orthopedic Association	116	100	62	37	1
American Association of Obstetricians and Gynecologists	167	100	73	24	3
American Pediatric Society	66	100	30	67	3
American Laryngological, Rhinological and Otological Society	196	100	66	33	1
Totals	861	100	56	42	2

The estimation of the relative scientific ability of members of the various groups is very difficult. Even if we could measure accurately each individual's scientific accomplishments we still might be in the dark concerning

of the kind herein analyzed, and who yet have added materially not only to the practise, but also to the science of medicine. Such individuals, however, must be so few that their omission would have relatively little to do with

the figures or the question in hand. I have, therefore, taken the membership lists of the various medical specialists' societies in the United States of which the data were obtainable, and have analyzed the scholastic attainments of the members as a matter of comparison. Elimination of duplicate memberships has not been attempted since it would have been both difficult and unfair.

The results of the analysis of the scholastic degrees of certain clinical medical societies of limited membership are shown in Table I.

68 per cent. have the M.D. degree, 28 per cent. the M.D. only, 34 per cent. the M.D. with the bachelor's degree, 6 per cent. the M.D. and the Ph.D., 22 per cent. the Ph.D. without the M.D. and 10 per cent. neither the M.D. nor the Ph.D. The percentage of those having the M.D. without the Ph.D. (62) is nearly three times that of those having the Ph.D. without the M.D. (22). When to the number of these members is added the number of men having similar attainments who are members of the clinical medical societies, we find that

TABLE II

Analysis of Scholastic Degrees of Members of Societies Covering the Fundamental Medical Sciences

Name of Society	Total Numbers Whose Degrees Were Found	Percentages					
		Total M.D.	M.D. Only	M.D. and A.B. or Equiv.	M.D. and Ph.D.	Ph.D.	Other Degrees
American Association of Anatomists	283	64	23	36	4	24	12
American Physiological Society	223	54	26	18	10	37	8
American Society of Biological Chemistry	153	41	13	16	12	50	9
American Bacteriologists	335	47	24	20	3	23	30
American Association of Pathologists and Bacteriologists	316	95	40	52	3	2	3
American Society for Experimental Pathology	40	100	30	60	10	0	0
American Society for Pharmacology and Experimental Therapeutics	74	87	49	26	12	13	0
American Society of Experimental Biology and Medicine	283	68	24	38	6	28	4
American Psychopathological Association	44	84	39	36	9	16	0
American Association for Cancer Research	89	94	40	49	4	3	2
Total	1,840	68	28	34	6	22	10
Compare with Analysis of Certain Clinical Medical Societies (Table I.)	861	100	56	42	2	0	0
			73				
"Who's Who in America" (1915 edition, selected names of those engaged in physical, chemical or biological sciences)	3,446	48	20	26	2	23	29

Membership in these clinical medical societies presupposes the possession of the M.D. degree. It is interesting to note that, taken as a whole, 56 per cent. of the 861 members have the M.D. degree only, while 44 per cent. have the M.D. with some other earned degree. It is also interesting to note that only 2 per cent. of the 861 members have the Ph.D. degree in addition to the M.D. degree.

An analysis of the scholastic degrees of the societies covering the fundamental medical sciences is shown in Table II. In these, the possession of the M.D. degree is not obligatory for membership. Of the total 1,840 members 73 per cent. of the total 2,701 have the M.D. degree, or the M.D. with the A.B. degree or its equivalent. Thus, it would seem that 73 per cent. of the men who have been responsible for the progress of American medicine started with only the scholastic equipment, at least so far as is indicated by their degrees, of the men now entering upon the study of specialties in medicine, while only 15 per cent. have the Ph.D. or B.Sc. degree.

Probably one third of the 2,701 members of the medical societies here studied are duplicates. In order to get a larger list and at the same time cover a broader field I have made

for comparison a similar analysis of the earned degrees of 3,446 persons engaged in any of the physical, chemical or biological sciences (including medicine), whose names appear in the 1915 edition of "Who's Who in America." The inclusion of a name in this publication indicates that its holder has attained a certain amount of public eminence though not necessarily of a kind indicated by his degree. An analysis of the degrees of these 3,446 persons shows that 48 per cent. have the M.D. degree, 20 per cent. have the M.D. only, 26 per cent. have the M.D. plus the A.B. or its equivalent, 2 per cent. have the M.D. plus the Ph.D., 23 per cent. have the Ph.D. without the M.D. and 29 per cent. have degrees other than M.D. or Ph.D. It therefore appears that in the field of physical, chemical and biological sciences the sort of eminence indicated by registry in "Who's Who" has been attained by twice as many with the degree of M.D. as with the degree of Ph.D.

An analysis of similarly selected names in "American Men of Science" was begun but abandoned since it was found that the latest (1910) edition does not include the names of many of the younger men who are largely responsible for the present progress of American medicine.

Until the later years of the last century the teaching of medicine in America, except in a very few schools, was a travesty on pedagogy. During the present century it has probably improved more than the teaching of any other science. To-day the man who obtains the M.D. degree from an institution with the equivalent of the "Minnesota standard," *i. e.*, including a final year's hospital or laboratory work, probably has quite as much scientific ability as the man who obtains the Ph.D. or D.Sc. degree from the same institution. This seems to be proved by the time he must study, by the character of the subject-matter of his studies, and by the probability of his accomplishing something in science in after life. If this be true and the M.D., Ph.D. and D.Sc. degrees from high-grade institutions represent an equivalent training, it must then appear that the three years of graduate training in a special branch of medicine now offered by the University of Minnesota should result in scientific ability just three years "to the good" of that represented by any one of the three doctorate degrees.

LOUIS B. WILSON

MAYO CLINIC,
ROCHESTER, MINN.

SCIENTIFIC EVENTS

THE RESEARCH CORPORATION

THE Research Corporation was incorporated in the State of New York in 1912 on the initiative of Dr. F. G. Cottrell, who gave to it his patents concerning the process known as the "electrical precipitation of suspended particles." The objects of the corporation are:

First: To build up a business organization which, so far as possible, should be a model of efficient administration, for the purpose of demonstrating the commercial value of the precipitation processes included in the original gift and of such other inventions as the corporation might acquire by gift or otherwise, and of making such inventions a source of profit.

Second: From the profits so earned to accumulate an endowment fund to be used for the intensive study of scientific and industrial needs, and to provide the means, through the testing of new discoveries and through study, investigation and experimentation, of supplying such needs.

During the year 1916 the pioneer period in the application and development of the electrical precipitation processes may be said to have been completed. The corporation, which began with a cash capital of ten thousand dollars, is now spending that amount every month and has in its service a staff of forty-five engineers and others engaged in field and office work. The assets of the corporation as reported by the auditors on February 16, 1917, in cash and securities, were $217,862.72. A laboratory has been established and experts have been employed to study the workings of the precipitation processes, and, if possible, to develop improvements and meet new problems. Careful consideration has also been given to other patents and processes which have been offered to the corporation, and

although none have as yet been accepted, it is the purpose of the corporation to lend its aid to the utilization of any invention or discovery which offers sufficient promise of promoting the application of scientific discovery to the industrial arts.

For the purpose of encouraging scientific research directed to the development of the industrial arts the research corporation offers a fellowship of the annual value of $2,500, to be awarded on competition under the following conditions:

1. The competition will consist of the submission of evidence of scientific attainments, discoveries or inventions, and of special fitness for advanced work.

2. All persons desiring to compete must fill in a form of application, which will be furnished by the secretary of the corporation upon request, and file the same on or before October 1, 1917, together with such letters of reference, scientific publications and other documents or evidence as they may desire to submit, including a specific statement of the particular field or object of the research or investigation which the competitor proposes to conduct and a pledge that he will devote himself faithfully to the prosecution of such research or investigation if awarded the fellowship.

3. The competition shall be decided on or before December 1, 1917, by a jury consisting of the president of the National Academy of Sciences, the secretary of the Smithsonian Institution, the presidents of the American Chemical Society and Research Corporation, respectively, and the chairman of the Engineering Foundation, or such persons as they may respectively designate to act for them.

4. The term of the fellowship shall be one year from the date of the award, but the term may be extended by the corporation for two renewals of one year each in exceptional cases upon the recommendation of the jury.

5. The stipend of each fellowship will be paid as follows: $300 on the award of the fellowship and $200 monthly thereafter for the remainder of the year.

6. Fellows will be required to report in writing at the office of the corporation within twenty days from the date of the award (unless the time shall be extended) and to begin their research or investigation at once. In case of their failure to do so, or in case they shall fail to prosecute the same with proper attention, the fellowship may be terminated by the corporation.

7. Any fellow who shall resign or retire before the conclusion of the term of his appointment, or who shall be dismissed by the directors of the corporation for cause, will forfeit all privileges and emoluments of his fellowship and have no claim to the further payment of his stipend.

8. The corporation will endeavor to secure for fellows the privileges of laboratories specially adapted for their particular work.

9. Each fellow shall make a written report to the corporation at the conclusion of his appointment of the results of the research or investigation which he has conducted. Any discovery or invention which he may make shall be deemed his personal property.

ANTHRACITE COAL MINED IN 1916

The anthracite mined in 1916 amounted to 78,195,083 gross tons, valued at $202,009,561, a decrease in quantity of 1.6 per cent. and an increase in value of 9.4 per cent. compared with 1915. The shipments decreased 1.7 per cent.—from 68,666,456 gross tons in 1915 to 67,501,363 tons in 1916. The shipments of prepared coal of sizes above pea in 1916 were 40,747,215 tons, a decrease of 1.1 per cent.; the shipments of pea size were 7,520,804 tons, a decrease of 8.4 per cent.; and the shipments of steam sizes smaller than pea were 19,233,344 tons, a decrease of but .05 per cent. compared with 1915. There was an increase of nearly 6 per cent. in the quantity of anthracite sold locally and used by employees and a decrease of 2.4 per cent. in the quantity used for mine fuel. The compilation of these statistics has just been completed by C. E. Lesher, of the United States Geological Survey, Department of the Interior.

The effect of the extraordinary demand for steam sizes of anthracite that followed the industrial activity in 1916 and the high price of bituminous coal is indicated in the figures showing the output of washery product and dredge coal. Although the freshly mined coal in the anthracite region, including Sullivan County, showed a decrease of 2.6 per cent. in 1916 compared with 1915 there was an increase of 19.6 per cent. in the quantity of anthracite obtained from the washeries, which

operate mainly on old culm banks, and an increase of 16 per cent. in the quantity of coal dredged from rivers.

The production in the Lehigh region was 10,929,055 gross tons; in the Schuylkill region, 23,659,448 tons; in the Wyoming region, 43,111,732 tons; and in Sullivan County (Bernice Basin), 494,848 tons.

There was a large decrease in the number of men employed in the production of anthracite in 1916, and the output was maintained only through an increase in the number of working days. The number of men employed in 1914 was 179,679; in 1915, 176,552; and in 1916, 159,869. The average number of days worked was 245 in 1914, 230 in 1915, and 253 in 1916. The average output per man per day in 1914 was 1.84 gross tons; in 1915, 1.96 tons, and in 1916, 1.93 tons. The average output per employee for the year was 451 tons in 1914; 450 tons in 1915; and 489 tons in 1916.

ANIMAL COLLECTIONS FROM AUSTRALIA

THE animal collections of the Zoological Park have been enriched by the arrival of another great "caravan" from Australia. After six months of diligent effort, and generous expenditures of money, Mr. Ellis S. Joseph brought together and successfully transported to New York the largest collection of rare species of mammals, birds and reptiles that ever came to America. The common species, such as for years have been coming to us through the regular European channels, are conspicuous by their well-nigh complete absence.

Naturally, the officers of the Zoological Society feel measurably elated over this coup, at a period of great depression in the wild-animal supply from other sources. The receipts from England are very trifling, and from the continent of Europe nothing whatever comes. In fact, in America the German wild-animal business is thoroughly dead. Our further operations in South Africa must be postponed until after the war.

Encouraged through his previous reception by the Zoological Society, Mr. Joseph redoubled his former efforts to bring to America something worth while. The collection which he landed in Victoria, B. C., a month ago represents a large outlay in money and effort, and great scientific value. Of that importation the Zoological Society has purchased mammals, birds and reptiles to a total cost of about $6,000. The Philadelphia Zoological Society has purchased $3,000 worth, and other purchases are proceeding.

The following list shows the newly acquired mammals:

1 thylacine,
3 hyraxes,
2 water mongooses,
1 echidna,
2 rabbit-eared bandicoots,
2 West Australian rat kangaroos,
1 tree kangaroo,
3 yellow-footed rock wallabies,
2 Woodward kangaroos and young,
1 wallaroo,
1 brush-tailed wallaby,
2 short-tailed wallabies,
1 Paddy Mellen wallaby,
2 rufus-necked wallabies,
2 Tasmanian black phalangers,
6 spotted phalangers,
3 dusky phalangers,
3 gray phalangers,
3 Papuan phalangers,
1 Australian phalanger,
4 marsupial mice,
3 Australian water rats.

The majority of our accessions will be found in the large bird house, the small deer house, the reptile house and the small mammal house, but the thylacine is in one of the small bear dens. Each new species is marked by a red label reading "Recent Accession." Incidentally it is to be noted that our total kangaroo collection is believed by Mr. Joseph to be the most extensive series ever brought together. It will be found in the small deer house.

W. T. HORNADAY,
Director

SCIENTIFIC NOTES AND NEWS

PROFESSOR MILO S. KETCHUM, dean of the College of Engineering of the University of Colorado, was elected president of the Society

for the Promotion of Engineering Education at the annual meeting of the society held recently at Washington.

Major Pearce Bailey, M.R.C., chairman of the committee on furnishing hospital units for nervous and mental disorders to the United States Government, has been asked by the Surgeon-General to serve as adviser in all matters pertaining to psychiatry and neurology.

The Electrical World states that Brigadier General George O. Squier, U. S. A., chief signal officer of the army, has been made a fellow of the Royal Society of England in recognition of his invention of a new system of ocean cabling which, it is believed, will be of the greatest service in the war.

Dr. Charles J. Bartlett, New Haven, director of the pathologic laboratory, Yale University, has been appointed director of the bureau of laboratories of the state department of health, succeeding the late Professor Herbert W. Conn. P. E. Bransfield, Ira D. Joel, Ira V. Hiscock and George E. Stookey, who were assistants to Professor Conn, have been appointed to similar positions by the new director. It has been decided to remove the laboratory from Middlebury to the Agricultural Experiment Station, New Haven.

Dr. Soca, professor at the University of Montevideo, former president of the republic of Uruguay, and Dr. Couto, professor of internal medicine at the Faculté de Rio-de-Janeiro, the former president of the Academy of Medicine of Brazil, have been elected members of the Paris Academy of Medicine.

The Russian Geographical Society at its annual meeting elected as honorary members Mr. Douglas Freshfield and Sir Aurel Stein, and as corresponding members Sir Ernest Shackleton and Mr. G. G. Chisholm.

One hundred Japanese physicians are said to be on the way to Roumania in charge of Dr. Motegi, chief of the Saiseikai Hospital and head of the surgical department of the Keio University.

Dr. Oliver Fassig has gone to San Juan on a special mission to extend and reorganize the Weather Bureau service in the West Indies. In the Virgin Islands a station is to be established, two stations are to be started in Haiti and one at Puerto Plata, Santo Domingo. The station in San Juan will probably be designated as the station in charge of the West Indies Service.

Professor E. W. Gudger, of the State Normal College, Greensboro, N. C., spent June and July at the American Museum of Natural History, in work on the "Bibliography of Fishes," of which Professor Bashford Dean and Dr. C. R. Eastman are editors.

Dr. Burton J. Lemon, formerly instructor in the department of chemistry of Cornell University, and during the last two years a chemist with the United States Rubber Company in New York, has received a commission as captain in the Quartermaster Officers' Reserve Corps.

Dr. H. B. North has recently resigned his professorship in chemistry in Rutgers College in order to become director of the research laboratories of the York Metal Alloy Co., of York, Pa.

Charles H. Tuck, professor of extension teaching in the New York State College of Agriculture, Cornell University since 1910, has resigned from the faculty. He has been absent on leave since January, 1916, when he went to Manchuria, and he is still there, engaged in agricultural investigations for an American syndicate. Maurice C. Burritt, extension professor and state director of farm bureaus in the college, has been elected to succeed Professor Tuck.

O. C. Charlton, until recently a teacher of biology, has been appointed city forester for Dallas, Texas.

Dr. Leon I. Shaw, of Northwestern University, has been advanced to the position of assistant professor of chemistry on leave of absence of one year for service with the United States government. He has received the appointment of first lieutenant of the Ordnance Officers' Reserve Corps.

According to the *Cornell Alumni Bulletin*, G. Harold Powell, general manager of the

California Fruit Growers' Exchange, has accepted an invitation from Herbert C. Hoover, to take charge of the distribution of all perishable goods in the United States. Mr. Powell is now in Washington. For many years he has made his specialty the study of the problems of food storage and transportation. From 1901 till 1911 he was in the bureau of plant industry of the U. S. Department of Agriculture.

DR. A. J. CARLSON, professor of physiology in the University of Chicago, recently delivered an address on "The recent advances in the physiology and pathology of the alimentary tract," before the faculty and students of the graduate summer quarter in medicine of the University of Illinois.

PROFESSOR ALBERT FREDERICK GANZ, of the Stevens Institute of Technology, known for his investigations on electricity, died by suicide on July 27, aged forty-five years.

DR. L. E. RUSSELL, formerly president of the American Medical Association, a physician and surgeon known nationally, died suddenly at his home in Springfield, Ohio, on August 2, aged sixty-six years.

WILLIAM WALLACE TOOKER, an authority on Indian nomenclature and archeology, died on August 1, after a long illness at his home in Sag Harbor, L. I., at the age of sixty-nine years.

DR. ROBERT BELL, F.R.S., formerly chief geologist of the Geological Survey of Canada, has died at the age of seventy-six years.

EDWARD STANFORD, F.R.G.S. (son of the founder of Edward Stanford, Limited, London, cartographers to the king) a well-known publisher and geographer of London, died on June 6. His life was one of continued activity in advancing the science of geography and map-making. He had charge of all the ordnance maps of the United Kingdom, and issued numerous atlases, monographs, and maps of all the countries of the world.

WE learn from *Nature* of the death of Professor K. R. Birkeland, of Christiania, which occurred in Tokyo on June 18. Professor Birkeland was largely interested in the extraction of nitrogen from the atmosphere and other industrial work, and is known to scientific men for his observation and theories on cosmical phenomena.

THE Fourth Annual Conference of the Society for Practical Astronomy will be held August 16, 17 and 18, at the University of Chicago. Professor F. R. Moulton, of the university, and Professor W. D. MacMillan will lecture at the sessions and there will be papers presented by other members of the society. The sessions are open to the public, and visitors from other cities, whether members of the society or not, are invited to attend.

SURGEON GENERAL GORGAS has issued a statement that medical students are not to be exempt from draft, but will be given conditional and limited furloughs to continue their medical studies. This furlough is intended to furnish an opportunity for the student to complete his studies and obtain his required year of hospital experience, so as to fit him for service in the medical department of the army. The Surgeon General, through the medical section of the Council of National Defense, is endeavoring to prevent the undue depletion of the civilian hospital staffs for service at the front.

A BILL has been introduced into the House of Representatives, providing that there shall be established one additional division each of mental hygiene and rural sanitation in the United States Public Health Service, and said divisions shall be in charge of commissioned medical officers of the United States Public Health Service, detailed by the Surgeon General, which officers, while thus serving, shall be assistant surgeons general within the meaning of section three of the act approved July 1, 1902, entitled "An act to increase the efficiency and change the name of the United States Marine Hospital Service." Sec. 2. That the duties of the division of mental hygiene shall be to study and investigate mental disorders and their causes, care and prevention. The duty of the division of rural sanitation shall be to investigate improved methods of rural sanitation, and the prevention and suppression of communicable diseases.

The *Journal* of the American Medical Association states that the Academy of Medicine of Toronto has adopted a resolution calling for one united medical service in Canada to take the place of the present arrangements of a Canadian Army Medical Corps and a Canadian Hospitals Commission. The academy urges that medical care of all soldiers be placed directly under a surgeon general, to be known as Surgeon General of Canada, who should be directly responsible to the minister of militia, who should have a seat in the militia council. He will perform the duties of director of medical services, invalids and be chief medical officer of the hospitals commission and of its executive. The academy recommended Surgeon-General John Taylor Fotheringham, C.M.G., Toronto, recently returned from overseas, for this position.

The emperor of Austria, according to the *Journal* of the American Medical Association, has organized a new state department, the chief of which is to be known as the minister of hygiene and social welfare.

The yacht *Anton Dohrn,* of the department of marine biology of the Carnegie Institution of Washington, has been offered to and accepted by the United States Navy for the period of the war.

The board of managers of the New York Botanical Garden announces plans to expend $500,000 in developing the garden. Three of the largest works projected are the construction of a museum laboratory wing which will cost $100,000, the building of a wing to the east museum to cost $100,000, and a central display greenhouse to cost $75,000. An orchid greenhouse will cost $24,000, and a like sum will be spent in building an economic plant greenhouse. Two tropic plant greenhouses, a garden school greenhouse, experimental and investigation greenhouses also are to be constructed. In a report of the garden's endowment committee it is announced that a contribution of $2,000 has been made by Mrs. Robert E. Westcott for the construction of the new rose garden stone stairway, and a gift of $4,000 has been made by Mrs. Frederick F. Thompson for the construction of the school garden shelter on the eastern bank of the Long Lake at the southern end of the new school garden.

The fourth meeting of the Conjoint Board of Scientific Societies of Great Britain was held on June 13 at the Royal Society, with Sir J. J. Thomson, F.R.S., in the chair. The report of the executive committee for the past half year showed that a number of questions of scientific and industrial importance have come before the board. Among these are the need for an anthropological survey of the British people, the maintenance of the international catalogue of scientific literature and the desirability or otherwise of adopting the metric system throughout the British Isles.

An opportunity for research work in sociology with some time for other graduate work if desired awaits a suitable applicant at the University of Chicago and for this $1,200 has been set aside for each of the two years it is expected the investigation will require. By this announcement it is hoped to secure some one already specializing in sociology. Inquiry for further details may be addressed to Professor Albion W. Small, University of Chicago, or to Dr. E. R. LeCount, Rush Medical College, Chicago.

The Bureau of Economic Geology of the University of Texas has just issued a report on the Thrall Oil Field by J. A. Udden, H. P. Bybee, E. P. Schoch and W. T. Read. This field was discovered three years ago, in Williamson County, and it proves to be unique for the United States, the greater part of the production coming from a metamorphic chlorite derived from an extremely basic igneous rock. This rock apparently represents a submarine eruption in the Cretaceous sea.

The *Medical Record* states that the Rockefeller Institute for Medical Research, through the research work of Dr. Carroll G. Bull and Miss Ida W. Pritchett, will undertake to supply the allied armies with a serum which is believed to be an effective antitoxin for the gas bacillus producing gangrene. Cultures of the gangrene bacillus were obtained in Europe last year and these investigators have experi-

mented upon animals and produced the hoped-for results.

UNDER the direction of Dr. Roger Adams, of the division of organic chemistry of the University of Illinois, a group of graduate students is engaged in preparing chemicals that are being sold to as many as fifteen different university laboratories, to the Bureau of Chemistry at Washington, to large distributing houses, and commercial firms. One chemical, for which there has been a shortage ever since the work began, is now being supplied from this laboratory in sufficient quantities to meet all demands of the country.

THE annual meeting of the Incorporated Society for Extending the Rothamsted Experiments in Agricultural Science was held on November 6. According to the report in the London *Times* Lord Crawford, president of the British Board of Agriculture, moved a resolution declaring that the work of the society was a matter of national importance deserving wide public support. He said that much would be expected from agriculture after the war, and much more, therefore, would have to be drawn from the knowledge, experience and guidance of such societies as that of Rothamsted. It would be really deplorable if any single branch of its activity had to be dropped during the war. It was at Rothamsted that the first practical demonstration of the value of artificial manures was consummated. He was fully conscious of the urgent necessity for the comprehensive treatment of this great subject, but the time was not yet ripe for any public announcement. Meanwhile, he trusted that the work of Rothamsted would continue and, in spite of the war, extend in the sphere and scale of its operations. In any future scheme he was certain that Rothamsted would take a high and honorable place, and would contribute to the research which was essential to the future of British agriculture. Dr. E. J. Russell, the honorable secretary and director of the Rothamsted Station, stated that the ordinary work at Rothamsted had been curtailed, but it was not being allowed to drop. Women had been brought in, and when peace came the men would come back to find the experiments a stage more developed than when they left. They could see the possibility of using to the great advantage of agriculture some of the machinery which was now being used for non-agricultural purposes. They hoped for some well-considered scheme for agricultural development in which the research stations, colleges, agricultural institutes and similar organizations would play a definite part.

Nature remarks: "The science of economic aviculture has probably reached a higher standard in the United States than in any other part of the world. This work is carried on by the Department of Agriculture, which, for years past, has spared no pains to enact laws and formulate schemes for the conservation of bird-life, whether for purely economic ends or for esthetic reasons. As a consequence, it has now available a mass of evidence as to the status and value of every species within its realms. The latest evidence of its enlightened policy takes the form of a bulletin—No. 465—on the propagation of wild-duck foods. The haunts and food values of no fewer than nineteen groups of plants, comprising sixty species, are here described, together with instructions as to stocking water in need of bait for these valuable birds. The characteristics of wild rice, wild celery, pondweeds, arrowheads, chufa, wild millet and water-lilies are all carefully set forth, and this information is accompanied by carefully collected data as to their attractiveness in regard to particular species of wild ducks. Had we followed its lead years ago our own Board of Agriculture would now be able to speak with authority when called on to sift the value of the crudely formed opinions of local agricultural chambers as to the usefulness or otherwise of our native birds in relation to our food supply. The latter is of vital importance, and the clamor for legislation is sometimes insistent. This war has done much for us already; perhaps it may yet bring into being a bureau of ornithology, such as is to be found now in

many Continental states, as well as in America."

According to *Nature* the newly formed Russian Botanical Society held its annual, and also a special, meeting at Moscow on December 16–19, 1916, and its organization was then completed. The following officers were elected: *Honorary President,* A. S. Famincyn; *President,* I. P. Borodin; *Vice-presidents,* V. I. Palladin and S. G. Navašin; *Chief Secretary,* N. A. Buš; *Treasurer,* V. N. Suchačev; *Members of the Council* in Petrograd, V. L. Komarov, S. P. Kostyčev and V. A. Tranšel. In addition, the following were elected on the council as representing cities containing a minimum of five members of the society: M. I. Golenkin (Moscow), E. F. Votčal (Kiev), V. M. Arnoldi (Charkov), B. B. Grineveckij (Odessa), V. V. Saponžnikov (Tomsk), Ja. S. Medvědev (Tiflis) and V. M. Arcichovskij (Novočerkassk). The number of the acting members of the society now exceeds 280. Notwithstanding the present unfavorable conditions, more than eighty members attended the four days' meeting in Moscow, and, in addition to the discussion and settlement of various questions of organization, sixteen scientific reports were read. The next extraordinary meeting is fixed for December, 1919, again in Moscow. Thanks to a subsidy of 3,000 roubles received from the Ministry of Public Instruction, it was possible towards the end of the year 1916 to proceed with the publication of the *Journal* of the Russian Botanical Society, and the first issue was placed before, and approved by, the Moscow meeting. The second issue is in the press and finishes the year 1916. For this year a subsidy of 10,000 roubles is being applied for, and it is intended to publish eight numbers of four to five sheets each. Thus the scientific amalgamation of Russian botanists, for which they have long striven, may be considered as achieved, and the formation under the auspices of the Imperial Academy of Sciences of the first all-Russian learned society is an accomplished fact.

Nature states that under the title of "Science in Russia" a new reference-book will be published in the present year, composed of two parts: (*a*) an index of all scientific institutions, societies, and higher schools in Russia; (*b*) an index of all persons working in these institutions and of private scientific workers. It will thus include in the first part the particulars hitherto supplied (but very incompletely as to Russia) by the "Minerva Jahrbuch"; while the second part will be similar to "Who's who in science," but will give, at least for 1916, not so much information about each individual. The difficult task of collecting the necessary material is already well in hand. The undertaking has been brought, through the Russian newspapers, to the knowledge of all those interested, and special forms are being supplied to the institutions and societies, many of which have already been returned with the necessary particulars. The work has been taken in hand by the Academy of Sciences of Petrograd and the scientific periodical *Priroda* (Nature) of Moscow. "Science in Russia" for 1916 will be edited by Professor V. N. Beneševič, and published conjointly by the Academy and the Journal *Priroda* in the latter part of this year. It will be issued annually. This publication will supply a long-felt need, as up to the present the only work of reference containing any information about the scientific institutions of Russia as a whole has been "Minerva." "Science in Russia" will help towards an exact evaluation of Russian scientific forces and activity, and will constitute an important step towards the promotion of closer scientific relations with the Allied countries.

According to the *Journal* of the American Medical Association, plans have been taken up with the government for the establishment of an outpatient department at Camp Admiral by the officers of the Maryland Psychiatric Base Hospital Unit, of which Dr. A. P. Herring is chairman, and Dr. W. R. Dunton, secretary. The chief object of this department will be to examine soldiers for mental and nervous disorders and to arrange for their treatment, but specialists of various sorts of physical disease will also volunteer their services. The purpose is to have volunteers go to

the cantonment at stated intervals and with army surgeons conduct thorough mental tests and physical examinations. The new psychopathic building at the Spring Grove State Hospital, designed for acute cases of mental disease, has been offered to the government, and if it is accepted, patients from Camp Admiral will be treated there. The psychopathic building will also be useful in treating soldiers returned from the front, 18 to 20 per cent. of whom, it has been found in England, are suffering from mental breakdown, temporary or permanent.

UNIVERSITY AND EDUCATIONAL NEWS

AUSTIN C. DUNHAM, of Hartford, has offered as a gift to the Connecticut Agricultural College at Storrs, his Newington farm, which he has made into one of the best equipped farms in the state. Mr. Dunham has spent about $50,000 in improving the property and offers it to the college simply on the condition that it be used for school purposes. The farm consists of 130 acres and has at present forty head of cows and heifers and sixty-five pigs. Four silos have been built, housing 150 tons of silage, and eighty tons of hay have been gathered.

ACCORDING to a decision handed down by the Supreme Court of Connecticut, Yale University must pay to the state inheritance taxes amounting to about $34,000. The university inherited about $750,000 from the estate of Justus B. Hotchkiss. The Probate Court decided that it was not liable to taxation on the ground that Yale, being exempted by law from paying taxes on property in this city, was thereby constituted a public institution receiving state aid.

Two members of the faculty of Cornell University who retired this year have been elected to emeritus professorships. They are George S. Moler, emeritus professor of physics, and R. C. Carpenter, emeritus professor of experimental engineering.

DR. VICTOR C. ALDERSON, consulting engineer of Boston, has been tendered the presidency of the Colorado School of Mines at Golden, Colo. Dr. Alderson served as president of the school for four years, retiring three years ago. He has not yet indicated whether he will accept.

PROMOTIONS in the faculty of the New York State College of Agriculture have been made as follows: Assistant professors promoted to the grade of professors: J. R. Schramm, botany; R. H. Wheeler, extension teaching; H. O. Buckman, soil technology.

PROFESSOR V. ASCOLI, of the chair of medical pathology of the University of Pavia, has been appointed professor of clinical medicine at Rome to succeed Bacelli.

DISCUSSION AND CORRESPONDENCE

CLIMATIC INDEX OF BONNEVILLE LAKE BEDS

BECAUSE of the fact that they have been thought to furnish undoubtable stratigraphic testimony in support of the conception of the duality of the Glacial Epoch the lacustral deposits of the Great Salt Lake basin of Utah hold at this time an especial interest. Where best exposed these beds occupy a vertical space of about 100 feet; but their total thickness is without question considerably greater than this figure. The main body of the formation comprises fine laminated calcareous materials, of uniform texture and yellow color. An upper section, of irregular thickness, from 2 to 20 feet, is notably limy, white and more or less indurated in certain layers. The white marly upper capping is sharply separated from the yellow lower beds by an irregular line of juncture which has every appearance of being a marked plane of unconformity.

The common historical interpretation of the general section is briefly this: The lower yellow beds are regarded as representing river silts deposited in the lake over a very long period of time when the early Bonneville water-level was nearly as high as the later Bonneville shore-line. The white marly beds are depositions of a shorter high-water stage of the lake. The irregular line between the white and yellow sections are viewed in the

light of an unconformity, the interval represented being a stage between two high water marks when the old lake-waters completely dried up. Early Bonneville yellow beds are correlated in time with a first epoch of humidity superinduced by conditions of glaciation; while the white later Bonneville beds belong to the second Glacial epoch. The two parts of the section are thus represented as being separated by an erosional interval of long duration, occupying a time between two epochs of large rainfall and notable ice-forming.

Two features in particular militate strongly against these deposits either being normal stream-silts or being laid down during two distinct epochs separated by a long epoch of excessive dryness. This simpler and very different interpretation for the phenomena presented does not postulate violent and frequent changes of climate. It appeals to no other than the ordinary climatic conditions and geologic processes that prevail to-day in the region. It takes into account only the familiar geological activities of the desert.

Close examination of the deposits discloses the fact that they are not typical stream-silts, but that they have a grain very much coarser. In size the individual particles appear to be about midway between those of normal clay and fine sand. Although obscurely laminated the material in all physical aspects seems to be essentially loess or adobe. Thus, instead of being normal river-silts swept into still water these deposits really represent dusts, borne by the winds from the neighboring deserts, that have dropped on the surface of the lake waters and have settled to the bottom.

Compared with desert deposits of other regions the white marly upper beds of the section which have such a variable thickness are essentially what the Mexicans call *caliche*. It is formed through ordinary soil tension by which lime salts of porous formations below are carried to the surface of the ground, where the water evaporates, leaving behind the solids. In some places there is sufficient lime deposited interstitially to give the beds the aspect of chalk. Upon further induration some layers passed into limestone.

The juncture of the yellow and white beds is a sharp, irregular line that is easily mistaken for an erosion uncomformity. That it is not at all probable that in the Bonneville basin this line actually represents uncomformable relationships between the beds above and those below is clearly indicated by the fact that the phenomenon is a common one throughout arid lands where porous formations reach sky.

The yellow Bonneville clays do not appear, therefore, to represent a deposit which was laid down during a high-water precursor of the high-stage Lake Bonneville; and the irregular line separating the yellow and white sections does not stand for a long interlacustrine epoch when the lake waters were completely desiccated, during a dry interglacial time. The white marls seem to be very recent in formation, produced directly from the yellow clays long after Bonneville waters had finally receded. Their especial climatic significance is manifestly very different from that formerly postulated. The ascribed peculiarities are really every-day desert phenomena.

Charles Keyes

Des Moines, Ia.

INTERNAL TELIA OF RUSTS

To the Editor of Science: A recent article[1] lists up the references in pathological literature regarding the production of internal rust spores. The present writer in 1912[2] described such internal production of teliospores in the leaf of *Xanthium Canadense*, in the following words:

> Within the mixture of parenchyma cells and mycelium, which replaces the normal tissue, there are cystlike bodies which are composed of masses of mycelium. These objects are hollow spheres, and from the inner surface arise telial spores exactly similar to those borne in the normal way upon the exterior of the leaf.

[1] "Discovery of Internal Telia Produced by a Species of *Cronartium*," by R. H. Colley, *Jour. Agr. Research*, VIII., No. 9, February 26, 1917, pp. 329–332.

[2] "Relations of Parasitic Fungi to their Host Plants," *Bot. Gazette*, LIII., No. 5, May, p. 381.

The writer is calling attention to this former note since it was included in an article upon a broader subject, which accounts for the oversight of the reviewer.

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PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

THE fifth number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

The laws of elestico-viscous flow: A. A. Michelson, department of physics, University of Chicago. A number of empirical formulas are given.

A new equation of continuity: Frederick G. Keyes, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology. A comparison of a modification of van der Waals' equation with experimental results extended over wide ranges, showing satisfactory agreement between the equation and experiment.

The classification of vascular plants: Edward W. Berry, Geological Laboratory, Johns Hopkins University.

Displacement interferometry in connection with U-tubes: C. Barus, department of physics, Brown University.

Attempt to separate the isotopic forms of lead by fractional crystallization: Theodore W. Richards and Norris F. Hall, Wolcott Gibbs Memorial Laboratory, Harvard University. One may infer that the molal solubilities of the nitrates are probably essentially identical, and that isotopes are really inseparable by any such process as crystallization.

Hybrids of Zea tunicata and Zea ramosa: G. N. Collins, Bureau of Plant Industry, U. S. Department of Agriculture.

Distribution of gall midges: E. P. Felt, New York State Museum, Albany, New York. A discussion of the existing distribution and of hypotheses concerning the way in which it may have been brought about.

Fertility and age in the domestic fowl: Raymond Pearl, Biological Laboratory, Maine Agricultural Experiment Station. There is a steady and progressive decline in fertility after the first breeding season.

A kinetic hypothesis to explain the function of electrons in the chemical combination of atoms: William A. Noyes, department of chemistry, University of Illinois.

Transverse displacement interferometry: Carl Barus, department of physics, Brown University.

The proteins of the peanut, Arachis hypogæa: Carl O. Johns and D. Breese Jones, Protein Investigation Laboratory, Bureau of Chemistry, Department of Agriculture, Washington. Peanut meal contains a high percentage of lysine and could well be used to supplement a diet of corn and wheat.

A design-sequence from New Mexico: A. V. Kidder, Phillips Academy, Andover, Mass. It has been possible to identify five successive steps in the modification of a design.

The equilibrium between carbon monoxide, carbon dioxide, sulphur dioxide and free sulphur: John B. Ferguson, Geophysical Laboratory, Carnegie Institution of Washington.

Physiological effect on growth and reproduction of rations balanced from restricted sources: E. B. Hart, E. V. McCollum, H. Steenbock and G. C. Humphrey, departments of agricultural chemistry and animal husbandry, University of Wisconsin. Studies pointing to the necessity of the accumulation of further information on the *physiological* behavior of feeding stuffs.

What determines the duration of life in metazoa? Jacques Loeb and J. H. Northrop, Laboratories of the Rockefeller Institute for Medical Research, New York. *Drosophila* has a temperature coefficient for the duration of life of the order of magnitude of that of the chemical reaction. Since we know that the duration of the larval stage is determined by a specific hormone, we must consider the possibility that the duration of life is also primarily determined by the formation of a hormone in the body.

The interrelation between diet and body condition and the energy production during mechanical work in the dog: R. J. Anderson and Graham Lusk, physiological laboratory,

Cornell University Medical College, New York City. The accomplishment of a given amount of mechanical work is always at the expense of a given amount of energy and the amount of energy required for the mechanical work is independent of the physical condition of the subject and of the quantity of carbohydrate present in the gastrointestinal tract.

Report of the annual meeting: Award of medals, research grants from the trust funds.

Edwin Bidwell Wilson
Massachusetts Institute of Technology,
Cambridge, Mass.

SPECIAL ARTICLES

NOTE ON THE SWELLING OF GELATINE AND AGAR GELS IN SOLUTIONS OF SUCROSE AND DEXTROSE

The tests reported in this note were made incidentally in connection with experiments by D. T. MacDougal[1] on the swelling of cactus tissues (*Opuntia*) and of certain artificial gels in water and in dilute solutions of acids and alkalis. The method was the same in all particulars as that described by MacDougal. Small plates cut from thin, dried sheets of the various gelatine-agar mixtures were placed in the sugar solutions and the increases in thickness which occurred as these plates imbibed water and swelled were measured by the auxograph. The experiments were at room temperature, which ranged between 60° and 70° F. (16° and 21° C.). In all cases the gels were the identical preparations used by MacDougal. The sucrose was the usual "c. p." grade. The dextrose was Merck's "highest purity." The sugar solutions were tested for neutrality to phenolphthalein and litmus. Sugar concentrations are in percentages by weight.

The results are given in the following tables as percentage increases in thickness of the gel plates after approximately 12 hours in the respective solutions. The original thicknesses were measured by a micrometer gauge. Preliminary tests for longer time periods indicated that the swelling was always complete or very nearly so, in 12 hours. In the tables, figures on a single horizontal line represent tests made at the same time and under substantially identical conditions, the only differences being between the concentrations of the sugar solutions.

[1] Science, N. S., Vol. XLIV., pp. 502–505, 1916.

EXPERIMENTS WITH SUCROSE

Gelatine (without Agar)

Distilled Water	0.5% Sucrose	2% Sucrose	5% Sucrose	25% Sucrose	50% Sucrose
250	315				
250	250	210	260	210	

Gelatine 100—Agar 1

630	670				
620		710	550	520	330

Gelatine 80—Agar 20

300	350				
550		400	450	500	250

Gelatine 50—Agar 50

875	850				
600		525	500	450	275

Gelatine 20—Agar 80

1,150	1,050				
1,100		1,375	1,150	1,175	425

Agar (without Gelatine)

825	733				
1,000		1,175	900	700	350

EXPERIMENTS WITH DEXTROSE

Gelatine (without Agar)

Distilled Water	2% Dextrose	5% Dextrose	25% Dextrose	50% Dextrose
260	310	240	210	210

Gelatine 80—Agar 20

300	450	400	500	375

Gelatine 50—Agar 50

625	525	400	375	350

Agar (without Gelatine)

1,200	1,175	900	725	500

For the sugar solutions having concentrations less than 25 per cent. the results do not differ from the results for distilled water more than is explainable by the accidental variation normal to the method when the temperature is not controlled precisely. The effects of one hundredth normal acid and alkali found by MacDougal were many times the variations here observed and one may conclude that neither sucrose nor dextrose, in concentrations under 25 per cent., has any important effect on the swelling of gelatine-agar gels in water; important, that is, in comparison with the effects of acids or alkalis. With sugar concentrations of 50 per cent. the data show a markedly lessened swelling of all the gels in sucrose and of the two low-gelatine gels in dextrose. It may be that the two high-gelatine gels also swell less in 50 per cent. dextrose but the decrease is not certainly determinable from the single test which was made. This decrease in swelling in concentrated sugar solutions is to be expected from analogy with the osmotic behavior of such solutions and does not indicate any specific effect of either sugar on the swelling or imbibition capacity of the gels themselves.

E. E. FREE

DESERT BOTANICAL LABORATORY

THE AMERICAN CHEMICAL SOCIETY
III

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. E. Howe, *Chairman*

S. H. Salisbury, Jr., *Secretary*

A new method of separating zinc from cadmium and the latter's determination iodometrically: ERIC JOHN ERICSON. The separation consists in crystallizing the zinc out as zinc sulphate or zinc ammonium sulphate. It may be applied to the determination of cadmium in ore or in spelter (after removing and determining lead). In the latter case, although a small trace of cadmium is entrained in the crystals, only one crystallization is deemed necessary in view of the large sample taken. After removal of zinc, the cadmium may be determined by any of the usual methods. An iodometric method is outlined.

The determination of cadmium in brass: E. SCHRAMM. Owing to the lack of any well-tried method for the determination of cadmium in brass, a series of analyses was carried out on brasses and on mixtures of salts with and without additions of cadmium. A procedure was developed which gives fairly reliable results for the small amounts of cadmium concerned. The method consists essentially in removal of the copper electrolytically from nitric acid solution, followed by separation of the cadmium from zinc with hydrogen sulphide, in solutions of regulated acidity and small volume. The cadmium is finally weighed as sulphate.

The electrometric titration of zinc: F. RUSSELL v. BICHOWSKY. In the potassium ferrocyanide method for determining zinc there are three principal sources of error: (1) Oxidation of the ferrocyanide by any nitric acid, chlorine, or bromine present; (2) precipitation of other metals along with zinc; (3) uncertainty of the end point. To remove the first source of error precautions such as the addition of SO_2 should be taken. To avoid the precipitation of other metals the rational procedure is to change the conditions of the ferrocyanide precipitation by carrying it out in solutions containing from 10 to 20 per cent. HCl. In these solutions zinc ferrocyanide is only slightly soluble, but lead, manganese, iron and copper ferrocyanides are very soluble. Since the ordinary indicators can not be used at this concentration of acid, an electrometric determination of the end point is adopted, which is found to be quicker and more accurate than the older methods. This consists in noting the point at which there is a sharp change in potential of the solutions against a platinum electrode. The apparatus is the same as that used in determining the end-point of oxidation and reduction reactions in the analysis of iron, vanadium, chromium, etc. Experiments on a number of salt mixtures show that the end point is not affected by the amount of acid or neutral salts present within reasonable limits, nor by the presence of iron, lead, manganese (up to 50 mg.), or by small amounts of copper and cadmium. The preliminary operations for the purification of the ore therefore lose their customary importance; comparative results show that the electrometric method is more rapid than the usual procedure.

The vapor pressure of zinc and related metals: JOHN JOHNSTON. A review of the somewhat scattered observations on the vapor pressure of high-boiling metals, and a reduction of the data yielding equations by means of which the vapor pressure at any temperature can be ascertained. Published observations on the volatility of metals, alone and from mixtures, are also summarized.

The new zinc fields of Kansas and Oklahoma: W. P. Haynes. A visit to the new zinc fields south of Baxter Springs, Kansas, and to Picher and Admiralty, Oklahoma, shows the great strides in production which this district is making. Small drilling rigs dotting the prairie mark the advance guard, prospecting to determine the value and extent of the ore bodies. Concentrating mills follow closely and give the appearance of a large city. The ore minerals in this new district are chiefly sphalerite with some galena and variable amounts of pyrite and marcosite. This ore is much richer than in the older Galena-Joplin district and frequently contains over 20 per cent. of sphalerite. The origin of the ores of this district is still somewhat in doubt, but the most recent researches by Siebenthal have led him to conclude that they have been produced from the disseminated sulphide minerals scattered through the Cambro-Ordovician limestones, by artesian waters transporting them in solution and ascending and depositing them in the open spaces of the cherty members (Grand Falls chert) of the Boone formation (Burlington or Mississipian limestone), which is the productive horizon in this region.

Recent investigations on the smelter smoke problem: A. E. Wells. At most smelters where large quantities of sulphide ores are being handled, serious efforts are being made to utilize through the manufacture of sulphuric acid, liquid dioxide or elemental sulphur, the sulphur dioxide which results from the roasting and smelting of these ores. However, at plants situated at a considerable distance from markets for these products, only a comparatively small amount of the sulphur can be so utilized. It is recognized that although the amount of the smelter waste sulphur gases that will be utilized in commercial products will be increased steadily, yet, for many years to come, these smelters will be obliged to waste large volumes of sulphur dioxide daily into the atmosphere. Therefore, efforts are being made to determine how, under different climatic and topographic conditions, these large volumes of sulphur dioxide can be discharged into the atmosphere without doing injury to vegetation in the surrounding country. In this paper the development of the methods for conducting these investigations were discussed briefly.

Notes upon the hydro-metallurgical and electrolytic treatment of zinc ore: E. E. Watts. After briefly discussing the treatment of zinc ore, the paper related the writer's experimental work upon the ore of the Sullivan Mine of Kimberly, B. C. This work served to develop a process that involved a sulphurous acid leaching of the ore, and further experimental work developed the Watts Process. By this process, zinc oxide obtained by any suitable means is treated in specially constructed electrolytic tanks for the recovery of zinc. The work done in the experimental plant of the Electro Zinc Company at Welland, Ont., was discussed.

Chemical examination of industrial brines: O. R. Sweeney and James R. Withrow. The value of chemical examination, from the manufacturer's standpoint, was discussed. The errors resulting from improper sampling were shown, and a suggestion for a standard method given. The constituents which it was thought should be determined were given; together with the form in which they should be reported. A standard procedure for determining the density was given and the best temperature to use was discussed. Suggestions for determining total solids from the author's experiences were given. Procedures for silica, iron and aluminum were given and shorter methods for calcium and magnesium in mineral waters. Barium, strontium, sodium, potassium and sulfuric acid procedures were given, also modifications of the methods for bromine determination.

Contribution to the industrial chemistry of chicle and chewing gum: Frederic Dannerth. The author presents methods for the valuation of commercial block chicle by determining moisture, viscosity, resins, proteins and carbohydrates and mineral matter. Twenty problems relating to the chewing gum industry are presented. The total exports of finished chewing gum, amounted in 1916 to $574,400, equivalent to approximately 718,000 pounds. This represents crude chicle equal to at least 179,000 pounds. The amount of chicle imported, manufactured and consumed in the United States in 1916 was approximately 7,031,000 pounds equivalent to 28,124,000 pounds of chewing gum. Researches are at present being carried out on the constituent elements of chicle—alpha chicl-alban; beta chicl-alban; gamma chicl-alban; chicl-fluavil, and chicl-gutta. These substances have been investigated by Tschirsch and later by Bosz and Cohen. The latter investigators have not entirely agreed with the results published by Tschirsch.

Apparatus for determining the specific gravity of natural gas: Chas. K. Francis. The apparatus is to be used according to the method proposed by

Bunsen, which is based on the fact that the specific gravity of two gases bear approximately the same ratios to each other as do the squares of their rate of flow when passing through a very small opening. The apparatus consists of a pipette or burette to which is sealed at right angles, just below the tip, a glass stopcock. To the tip of the burette another stopcock is sealed which is provided with a very small, practically invisible opening. The gas to be examined is admitted through the larger side opening and the time of escape is measured through the small opening. A sample of air is measured in the same manner. The following example will serve as an illustration: The time required for the sample of gas to escape was 13.4 seconds and for the same quantity of air, 11.8 seconds; these squared are equal to 190.4 and 129.9. As the specific gravity of natural gas is referred to air as unity, the specific gravity is obtained by dividing 129.9 by 179.5 = 0.723 the specific gravity of the gas.

Comparative results from experiments in the distillery with open and closed fermenters: NIELS C. ORTVED. A closed iron fermenter of the latest type with a capacity of 4,000 liters was brought from Germany in 1914 and a wooden open tub of the same capacity was constructed. Eleven experiments were made, fermenting simultaneously mash from the same batch in both vessels. The results obtained were in favor of the closed fermenter, viz., lower acidity in the finished beer, and increased yield, amounting to one per cent. of spirit. The yields from the open fermenter corresponded to the average yields obtained in the ordinary normal runs of the distillery.

The effects of exposure of some fluid bitumens: CHARLES S. REEVE and RICHARD H. LEWIS. The work described was a continuation of that begun by Hubbard and Reeve (*Jour. of Indus. and Eng. Chem.*, 1913), and of later results published by Reeve and Anderton in the *Journal of the Franklin Institute*, October, 1916. Experiments were carried out along similar lines to those previously followed, using fluid types of products which had not been previously investigated. Exposure tests conducted for a period of one year show that certain types of petroleum harden materially while others are relatively little changed in their physical character, although all are materially changed in their composition as shown by the change in percentage of bitumen insoluble in naphtha and free and fixed carbon values. The relation between amounts volatilized upon heating for various periods in a laboratory oven at 163° C. and the amounts lost upon atmospheric exposure were shown by tables, and relations between the characters of the residues obtained by the two methods of volatilization were given. As in the previous work referred to, the changes which occur in bitumens upon exposure are notably greater than can be accounted for by mere loss of volatile constituents, and are due to chemical changes in the constitution of the bitumen itself.

The thermal and pressure decomposition of an absorbent oil: GUSTAV EGLOFF. An absorbent oil derived from a Pennsylvania crude petroleum, specific gravity 0.828/15.5° C. and 95.3 per cent. boiling between 250° C. and 350° C. was subjected to temperature conditions of 550° C., 600° C. and 650° C. in the gas phase at one and eleven atmospheres pressure. The above conditions of temperature and pressure gave the following percentages of gasoline, benzene, toluene and zylenes on basis of oil used.

Basis of Oil Used	Temperature Pressure in Atmospheres					
	550° C.		600° C.		650° C	
	I	II	I	II	I	II
Per cent. gasoline...	11.6	19.5	16.4	18.8	16.8	14.2
" benzene...	0.0	0.0	0.8	3.4	2.5	5.5
" toluene...	0.6	1.7	1.5	4.4	2.9	4.4
" xylenes...	0.3	1.7	0.6	2.8	1.6	2.2

The formation of benzene and toluene by the action of aluminum chloride on solvent naphtha: GUSTAV EGLOFF. Solvent naphtha derived from the thermal decomposition of coal, having a specific gravity of 0.867/15.5° C. and 93 per cent. distilling between 135° and 160° C. with the dry point at 181° C. was treated with anhydrous aluminum chloride. Five per cent. by weight of $AlCl_3$, was added to one liter of solvent naphtha and distilled over in two hours from a Hempel flask until 78 per cent. came over. The distillate was neutralized with caustic, washed and dried over calcium chloride. The distillate upon analysis gave on the basis of solvent naphtha used 1.2 per cent. of benzene and 13.9 per cent. of toluene.

The determination of available oxygen in oxidized manganese ores: O. L. BARNEBEY. The oxalic acid method is in common use in America for the determination of available oxygen in oxidized manganese ores and hence is the basis for the evaluation of such ores for certain industrial purposes. This method gives inconsistent results causing much difficulty in control work involving the use of pyrolusite and similar products. The

method is shown to be highly empirical, the errors being produced by decomposition of the oxalic acid by the action of the light in the presence of manganese salts. A modified ferrous sulfate method is accurate and is recommended for factory control work. The latter method gives results in close agreement with results obtained by Bunsen's distillation method and a new direct iodimetric method worked out by the author.

Some relations of the effect of over-heating to certain physical and chemical properties of asphalts: A. W. Hixson and Harold E. Hands. An oil asphaltic cement, a brick filler fluxed with an asphaltic oil residuum and a crude Trinidad asphalt were heated to various temperatures between 163° C. and 350° C. under uniform conditions. Physical and chemical analyses were made on the products of the various heatings. The results show that heating asphalts above certain temperatures change both the physical and chemical properties. The carbene content was not changed materially until the temperature of heating was above 200° C. Above that temperature there was a decided increase in carbenes. The results seem to indicate that carbenes are the result of cracking paraffine and asphaltic hydrocarbons into napthenes and unsaturated hydrocarbons. Moderate heating may so change the nature of the asphalts as to render them more soluble in carbon tetrachloride than in carbon disulphide. Overheating causes marked changes in natural and oil asphalts which render them unfit for many structural purposes. Two hundred and thirty-five degrees Centigrade is probably the maximum temperature to which an asphalt may be heated without permanent injuries to its useful properties and for certain structural purposes they should not be heated above 200° C. It is believed that the fixed carbon content when corrected to the original weight before heating offers a means of tracing the changes in the molecular structure of the hydrocarbons when they are subjected to the influence of heat. There is a close relation between the carbene value and the physical and chemical properties of asphaltic materials. The carbene specification is important for asphaltic materials for construction purposes.

Chemical Industry in Canada: H. E. Howe. The paper outlined something of the chemical industry in Canada, with special reference to recent important developments and new processes which have been perfected under the stimulating influence of war conditions, but which will become important factors in the chemical business after the war. It also recounted something of the natural resources of Canada as indicating the raw materials upon which chemical processes and industries may eventually be based, concluding with the statement of the steps that are being taken by private corporations, educational institutions and the government to apply scientific and industrial research looking toward the more economic utilization of natural resources and the establishment of chemical industries to serve a population which will undoubtedly increase at an abnormal rate following the declaration of peace.

The availability of nitrogen in fertilizers. A new method based on the nitrogen rendered water-soluble by incubation with a fertile soil: J. P. Schroeder. Theoretical and practical considerations governing the availability of substances for plant nutrition in recent researches dealing with the assimilation of various forms of nitrogen and the merits of various methods for determining availability were discussed. A proposed method consists of incubating a small sample of fertilizer with a 100 gm. portion of fertile soil at 30° C., maintained just below its critical moisture content and determining the total nitrogen that has been converted into the water-soluble form. It differs from the nitrification method and the ammonification method in that it takes into consideration both of those forms of nitrogen; also that in the form of nitrites and soluble protein compounds, all of which are assumed to be available or readily convertible into available form. It makes possible a shorter incubation period than in the nitrification method and the use of the exact ammonia determination instead of the difficult nitrate estimation.

The fertilizer value of city wastes—II., garbage tankage: J. P. Schroeder. The origin and composition and principal methods of rendering garbage were briefly outlined. Complete analyses of twenty samples of garbage tankage, representing all the larger garbage reduction plants in operation in this country, show on the average 3.3 per cent. ammonia, 7.84 per cent. bone phosphate and 0.80 per cent. potash, after removal of the oil, which usually amounts to about 12 per cent. Calculations based on these analyses and on figures showing production in cities of 50,000 and over, call attention to the large source of ammonia available. The availability of this ammonia for plant use is shown by experiments with different methods, and the general applicability of the material for fertilizer purposes based on its physical and chemical properties was discussed.